WHAT IS CLAIMED IS:

1. An image forming apparatus, comprising:

a photosensitive member configured to have a latent image written on a surface thereof;

a modulation data storage device configured to store a plurality of different gray-scale pulse sets, each of said plurality of different gray-scale pulse sets including a plurality of gray-scale pulses having pulse widths differing from each other in steps of a predetermined value based on gray-scale information corresponding to gray-scale input image data values, wherein each of said plurality of gray-scale pulses are formed from a combination of at least two pulses including at least one of a left-positioned pulse and a right-positioned pulse;

a pulse width modulator configured to select a gray-scale pulse set from among said plurality of different gray-scale sets stored in said modulation data storage device in accordance with said gray-scale information contained in input image data, said pulse width modulator being configured to perform a pulse width modulation operation to control a light beam to turn on and off in accordance with said input image data at a rate corresponding to at least twice an image density of said input image data by using said gray-scale pulse set selected; and

an optical writing mechanism configured to scan said light beam on said photosensitive member to form a latent image in accordance with said input image data.

2. The apparatus as defined in Claim 1, wherein said pulse width modulator is configured to control the light beam to turn on and off at a rate corresponding to at least twice an image density of said input image data in a main scanning direction.

3. The apparatus as defined in Claim 1, wherein said pulse width modulator is configured to control the light beam to turn on and off at a rate corresponding to at least twice an image density of said input image data in a sub-scanning direction.

4. The apparatus as defined in Claim 1, wherein said pulse width modulator is configured to control the light beam to turn on and off at a rate corresponding to at least twice an image density of said input image data in both main scanning and sub-scanning directions.

5. The apparatus as defined in Claim 1, wherein each of said plurality of gray-scale pulses includes the right-positioned pulse and the left-positioned pulse.

6. The apparatus as defined in Claim 1, further comprising:

an input mechanism configured to receive input information for predefining or changing the gray-scale pulses included in said plurality of gray-scale pulses of said gray-scale pulse set prestored in said modulation data storage device.

7. The apparatus as defined in Claim 1, further comprising:

a source of said light beam that includes a red laser diode having a light output in a 650 nm wavelength range.

8. The apparatus as defined in Claim 1,

wherein said pulse width modulator is configured to perform said pulse width modulation operation for said input image data of yellow, magenta, cyan, and black colors; and

wherein said optical writing mechanism is configured to form said latent image with yellow, magenta, cyan, and black colors on said photosensitive member in accordance with said input image data of yellow, magenta, cyan, and black colors, respectively, by causing said light beam to scan said photosensitive member, said light beam being controlled in accordance with said input image data of yellow, magenta, cyan, and black colors, respectively.

9. The apparatus as defined in Claim 1, wherein said predetermined value is a one-eighth of a pixel of said image data to be input.

10. An image forming apparatus, comprising:

photosensitive member means including a surface configured to receive a latent image;

modulation data storing means configured to store a plurality of different gray-scale pulse sets, each of said plurality of different gray-scale pulse sets including a plurality of gray-scale pulses having pulse widths which differ from each other in steps of a predetermined value corresponding to gray-scale information including a plurality of gray-scale values contained in input image data, each of said plurality of gray-scale pulses being formed of a combination of at least two pulses including at least one of a left-positioned pulse and a right-positioned pulse;

pulse width modulating means configured to select a gray-scale pulse set from among said plurality of different gray-scale pulse sets stored in said modulation data storing means in accordance with gray-scale information contained in the input image data, pulse width modulating means being configured to perform a pulse width modulation operation to control a light beam to turn on and off in accordance with said input image data at a rate corresponding to at least

twice an image density of said input image data by using said gray-scale pulse set selected; and

optical writing means configured to cause said light beam to scan said photosensitive member means so as to form a latent image on said photosensitive member means in accordance with said input image data.

11. The apparatus as defined in Claim 10, wherein said pulse width modulating means is configured to control the light beam to turn on and off at a rate corresponding to at least twice an image density of said input image data in a main scanning direction.

12. The apparatus as defined in Claim 10, wherein said pulse width modulating means is configured to control the light beam to turn on and off at a rate corresponding to at least twice a image density of said input image data in a sub-scanning direction.

13. The apparatus as defined in Claim 10, wherein said pulse width modulating means is configured to control the light beam to turn on and off at a rate corresponding to at least twice an image density of said input image data in both main scanning and sub-scanning directions.

14. The apparatus as defined in Claim 10, wherein each gray-scale pulse included in said gray-scale pulse set includes a combination of a right-positioned pulse and a left-positioned.

15. The apparatus as defined in Claim 10, further comprising:

inputting means for inputting information for predefining or changing said plurality of gray-scale pulses included in said plurality of different gray-scale pulse sets prestored in said modulation data storing means.

16. The apparatus as defined in Claim 10, further comprising:

a source of said light beam that includes a red laser diode having a light output in a 650 nm wavelength range.

17. The apparatus as defined in Claim 10,

wherein said pulse width modulating means is configured to perform said pulse width modulation operation for said input image data of yellow, magenta, cyan, and black colors; and

wherein said optical writing means is configured to form said latent image with yellow, magenta, cyan, and black colors on said photosensitive member means in accordance with said

input image data of yellow, magenta, cyan, and black colors, by causing said light beam to scan said photosensitive member, said light beam being in turn controlled in accordance with said input image data of yellow, magenta, cyan, and black colors.

18. The apparatus as defined in Claim 10, wherein said predetermined value is a one-eighth of a pixel of said input image data.

19. A method of image forming, comprising steps of:

storing a plurality of different gray-scale pulse sets, each of said plurality of different gray-scale pulse sets including a plurality of gray-scale pulses having pulse widths different from each other in steps of a predetermined value in accordance with gray-scale information including a plurality of gray-scale values possibly contained in image data to be input, each of said plurality of gray-scale pulses being made of a combination of at least two pulses including at least one of a left-positioned pulse and a right-positioned pulse;

entering input image data;

selecting a gray-scale pulse set from among said plurality of different gray-scale pulse sets in accordance with gray-scale information contained in said input image data entered in said entering step;

performing a pulse width modulation operation using gray-scale pulses included in said gray-scale pulse set selected by said selecting step to control a light beam to turn on and off in accordance with said input image data at a rate corresponding to at least twice an image density of said input image data entered in said entering step; and

controlling said light beam to scan a photosensitive member and form a latent image on said photosensitive member in accordance with said input image data entered in said entering step.

20. The method as defined in Claim 19, wherein said performing step performs said pulse width modulation operation to control said light beam to turn on and off at a rate corresponding to at least twice an image density of said input image data in a main scanning direction.

21. The method as defined in Claim 19, wherein said performing step performs said pulse width modulation operation to control said light beam to turn on and off at a rate corresponding to at least twice an image density of said input image data in a sub-scanning direction.

22. The method as defined in Claim 19, wherein said performing step performs said pulse width modulation operation

to control said light beam to turn on and off at a rate corresponding to at least twice an image density of said input image data in both main scanning and sub-scanning directions.

23. The method as defined in Claim 19, wherein each gray-scale pulse in said gray-scale pulse set includes a right-positioned pulse and a left-positioned pulse.

24. The method as defined in Claim 19, further comprising a step of:

inputting information to predefine or to change each gray-scale pulse of said plurality of gray-scale pulse sets prestored in said storing step.

25. The method as defined in Claim 19, wherein a source of said light beam is a red laser diode having a light output in a 650 nm wavelength range.

26. The method as defined in Claim 19, further comprising steps of:

selecting, in said selecting step, a suitable gray-scale pulse set from among said plurality of different gray-scale pulse sets in accordance with gray-scale information contained in yellow, magenta, cyan, and black color image data included in said input image data entered by said entering step each

time one of said yellow, magenta, cyan, and black color image data is processed; and

performing, in said performing step, said pulse width modulation operation using gray-scale pulses included in said suitable grayscale pulse set selected in said selecting step to control said light beam to turn on and off in accordance with each of said yellow, magenta, cyan, and black color image data; and

controlling, in said controlling step, said light beam to scan a photosensitive member to form a latent image on said photosensitive member in accordance with gray-scale information contained in each of said yellow, magenta, cyan, and black color image data included in said input image data entered in said entering step each time one of said yellow, magenta, cyan, and black color image data is processed.

27. The method as defined in Claim 19, wherein said predetermined value is a one-eighth of a pixel of said input image data.

28. An image forming apparatus, comprising:

a photosensitive member with a surface configured to receive a latent image corresponding to input image data;

an optical writing mechanism configured to scan a light beam on said photosensitive member to form said latent image;

and

a pulse width modulator configured to control said light beam based on said input image data, said light beam being controlled to turn on and off at a rate corresponding to at least twice an image density of said input image data;

wherein said latent image is formed using a gray-scale pulse set which includes a plurality of gray-scale pulses of pulse widths which differ from each other, said plurality of gray-scale pulses each being formed from a combination of at least two pulses.

29. The image forming apparatus as defined in Claim 28, further comprising:

a storage memory configured to store a plurality of different gray-scale pulse sets;

wherein said pulse width modulator is configured to select one of said plurality of different gray-scale pulse sets for controlling said light beam.

30. The image forming apparatus as defined in Claim 29, wherein said combination of at least two pulses for one of said plurality of gray-scale pulses includes a left-positioned pulse and a right-positioned pulse.

31. The image forming apparatus as defined in Claim 29,

wherein said combination of at least two pulses for one of said plurality of gray-scale pulses includes a left-positioned pulse and another left-positioned pulse.

32. The image forming apparatus as defined in Claim 29, wherein said combination of at least two pulses for one of said plurality of gray-scale pulses includes a right-positioned pulse and another right-positioned pulse.

33. The image forming apparatus as defined in Claim 29, wherein said pulse width modulator performs a pulse width modulation operation to control said light beam to turn on and off at a rate corresponding to at least twice an image density of said input image data.

34. The image forming apparatus as defined in Claim 33, further comprising:

a light beam source that includes light output at 650 nm wavelength.

ABSTRACT

An image forming apparatus includes a modulation data storage, a pulse width modulator, and an optical writing mechanism. The modulation data storage stores different gray-scale pulse sets. Each set includes gray-scale pulses having pulse widths different from each other in steps of a predetermined value corresponding to gray-scale information possibly contained in image data to be input. Each gray-scale pulse includes at least two pulses including at least one of left-positioned and right-positioned pulses. The pulse width modulator selects a gray-scale pulse set from among the different gray-scale sets in accordance with gray-scale information and performs a pulse width modulation to control a light beam on and off at a density twice or more than twice a density of the input image data by using the gray-scale pulse set selected. The optical writing mechanism causes the light beam to scan a photosensitive member to form a latent image thereon.

FIG. 1

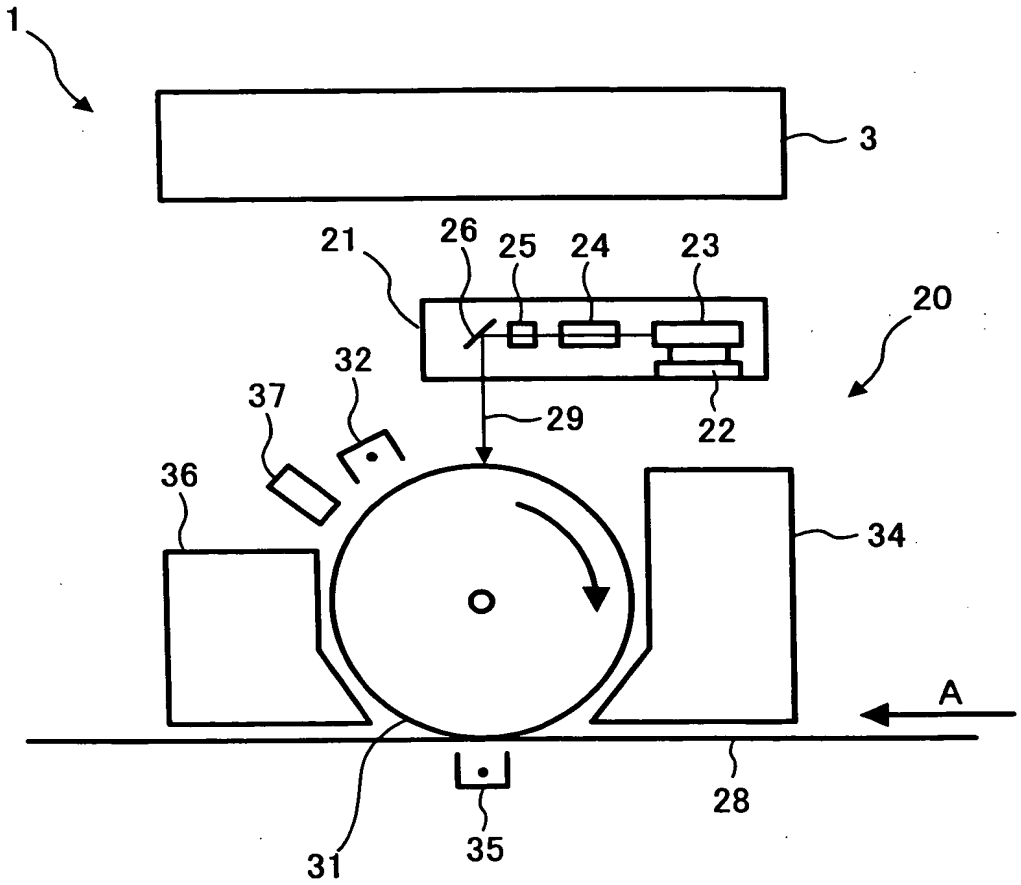
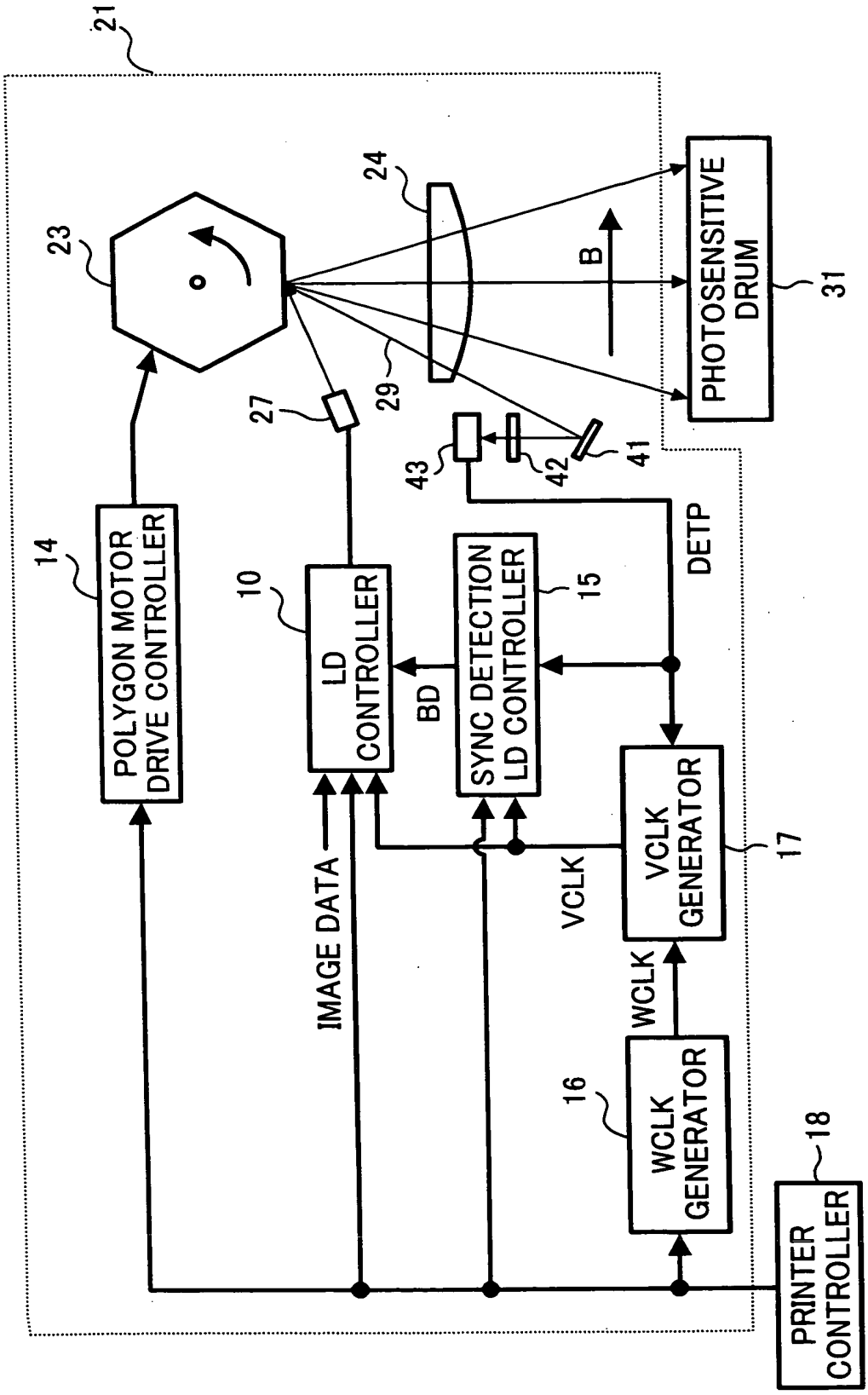


FIG. 2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PHOTOSENSITIVE DRUM
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POLYGON MOTOR DRIVE CONTROLLER
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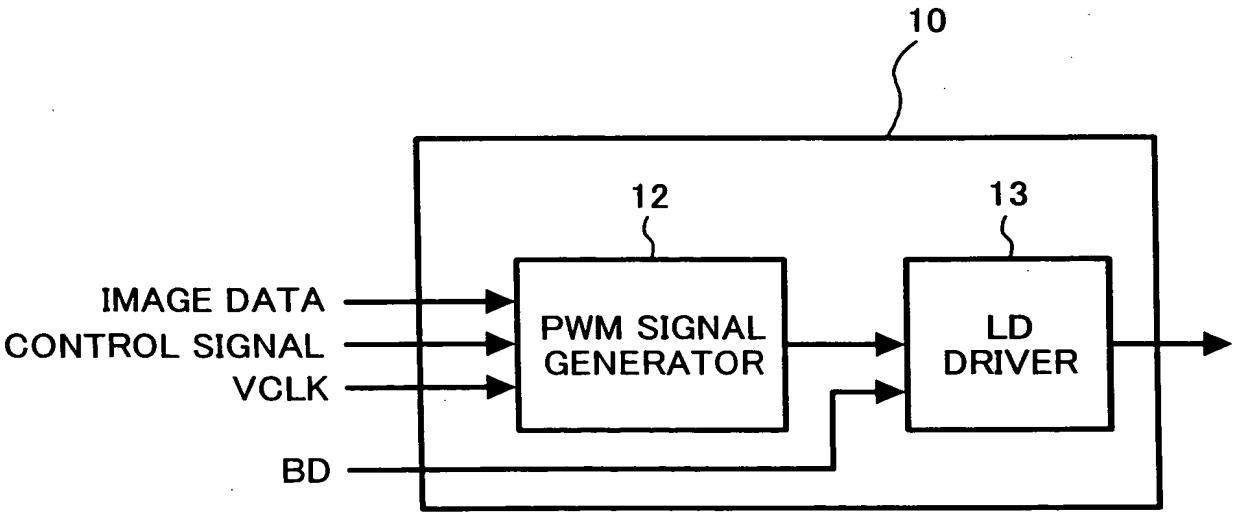
LD CONTROLLER
BD
SYNC DETECTION LD CONTROLLER
15
DETP
IMAGE DATA
VCLK
VCLK GENERATOR
17
WCLK
16
WCLK GENERATOR
18
PRINTER CONTROLLER

FIG. 3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12
13
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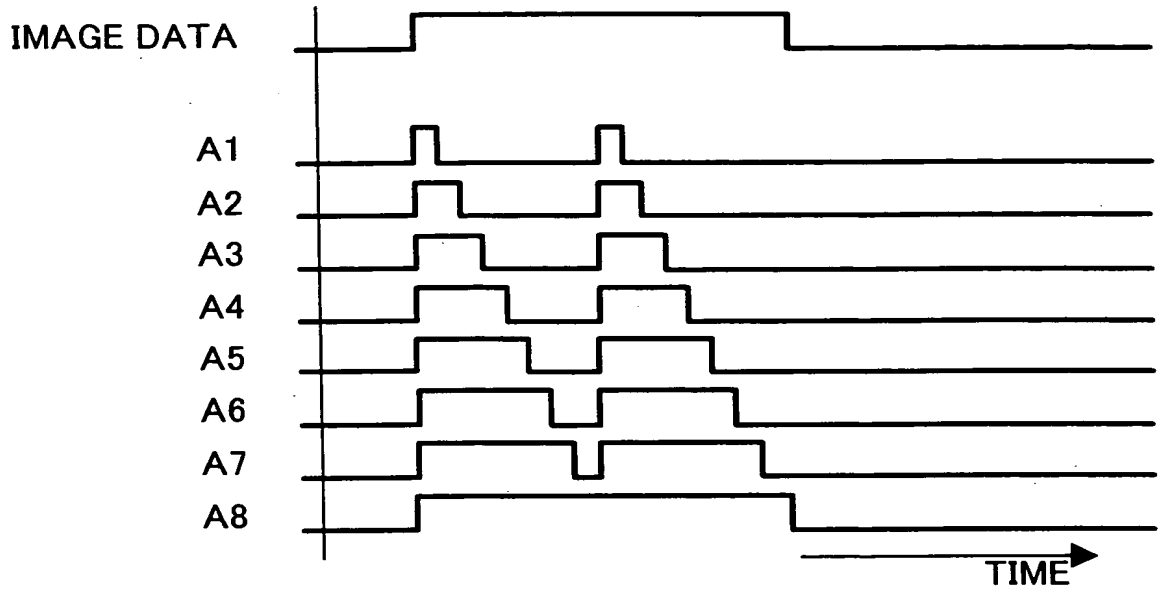
CONTROL SIGNAL
VCLK
BD
PWM SIGNAL GENERATOR
LD DRIVER

FIG. 4A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A2
A3
A4
A5
A6
A7
A8
TIME

FIG. 4B

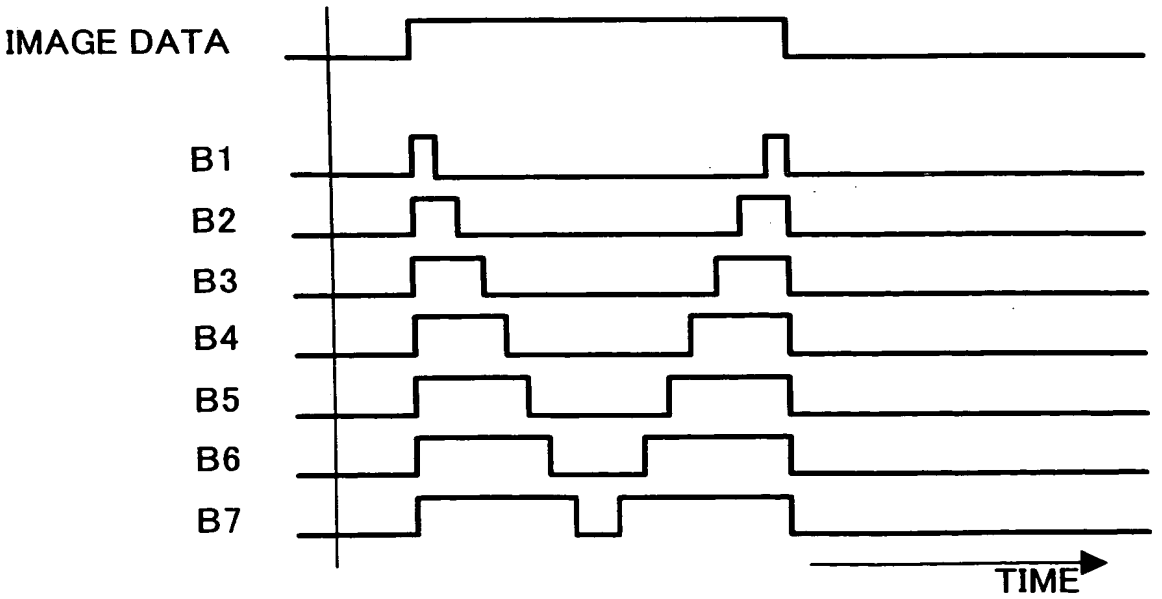
IMAGE DATA
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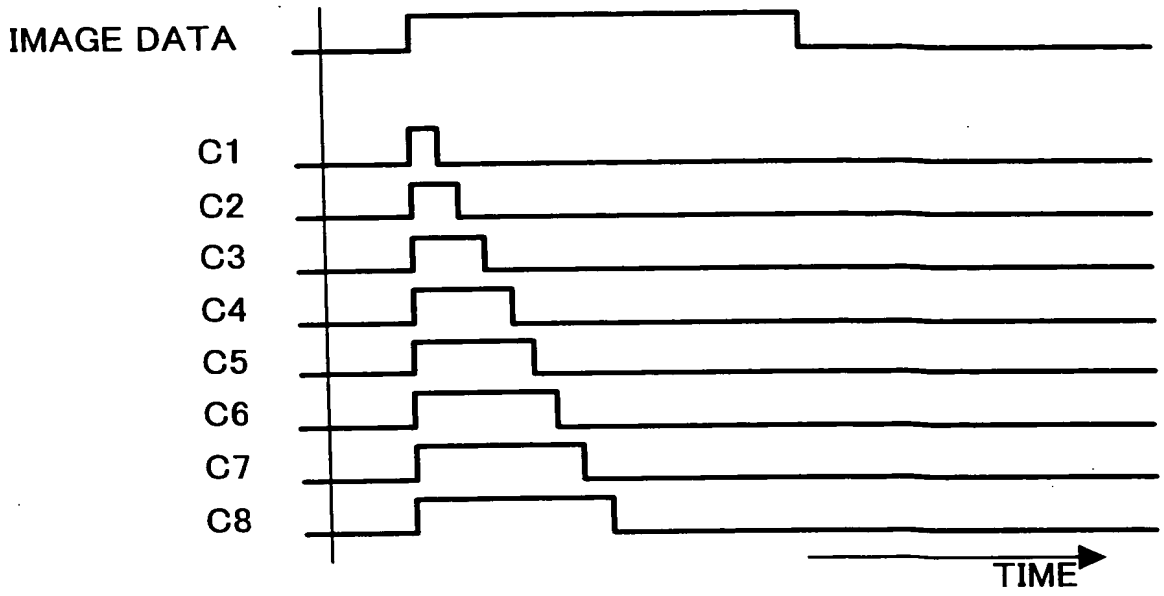
B3
B4
B5
B6
B7
TIME

FIG. 4C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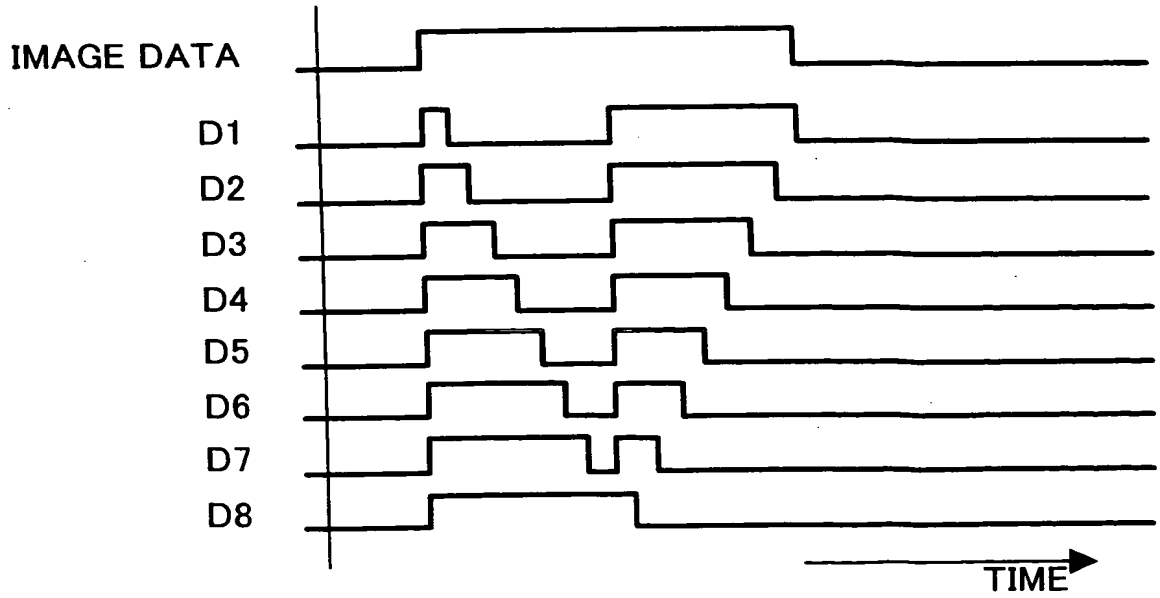
C4
C5
C6
C7
C8
TIME

FIG. 4D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TIME

FIG. 5A

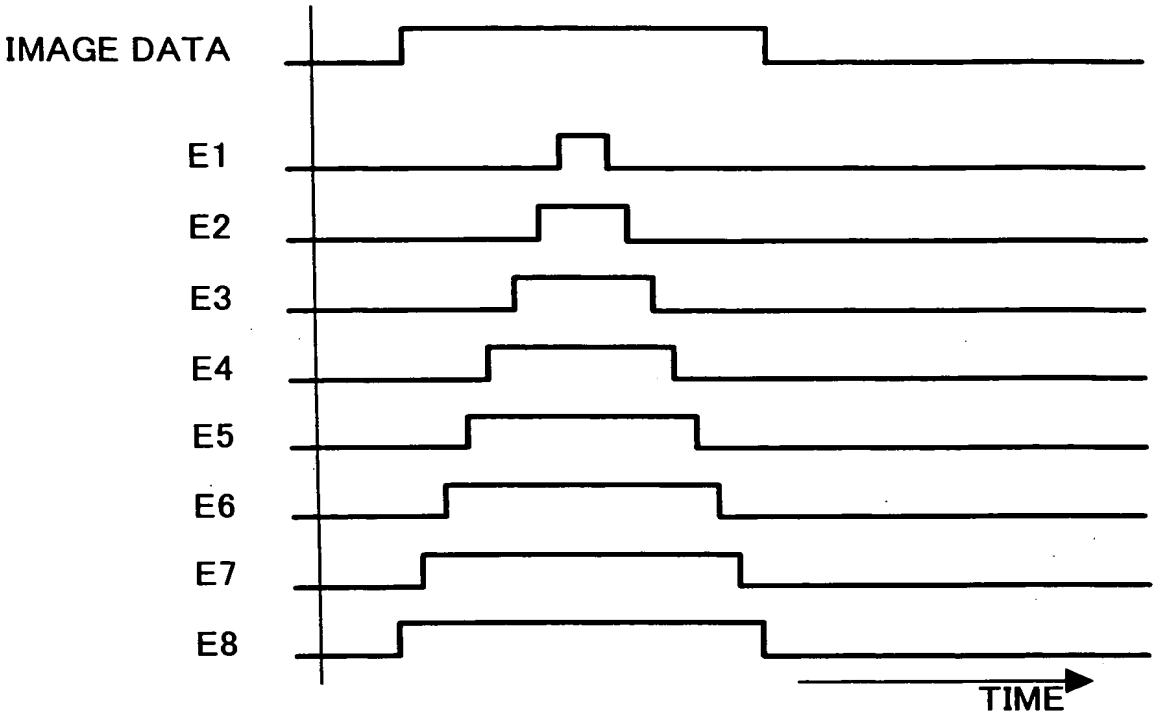
IMAGE DATA
E1
E2
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E5
E6
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E8
TIME

FIG. 5B

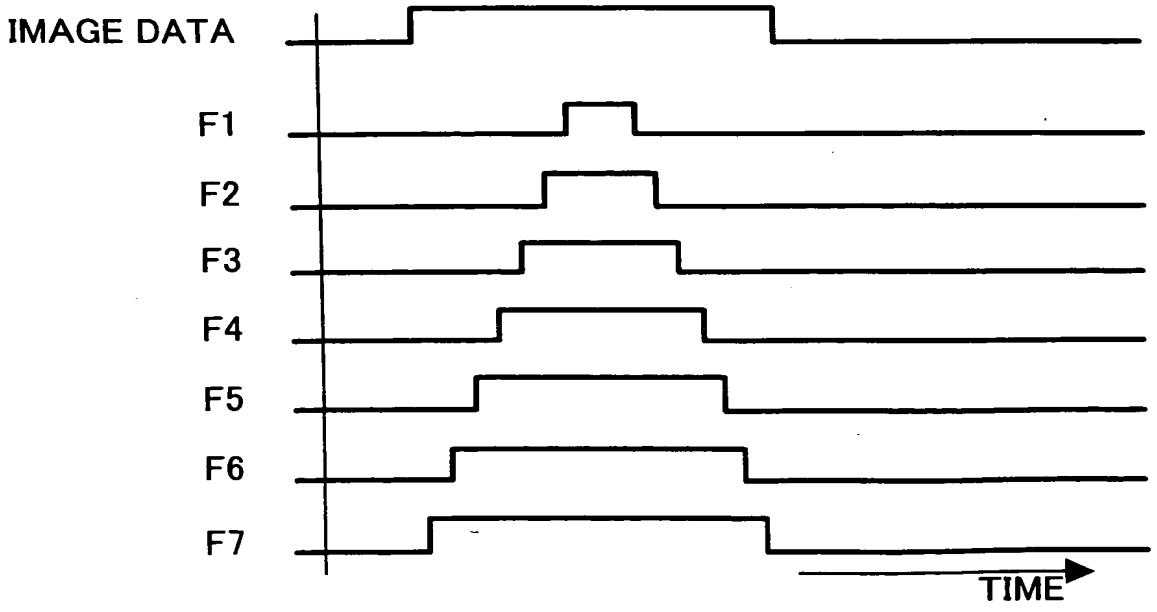


IMAGE DATA
F1
F2
F3
F4
F5
F6
F7
TIME

FIG. 6A

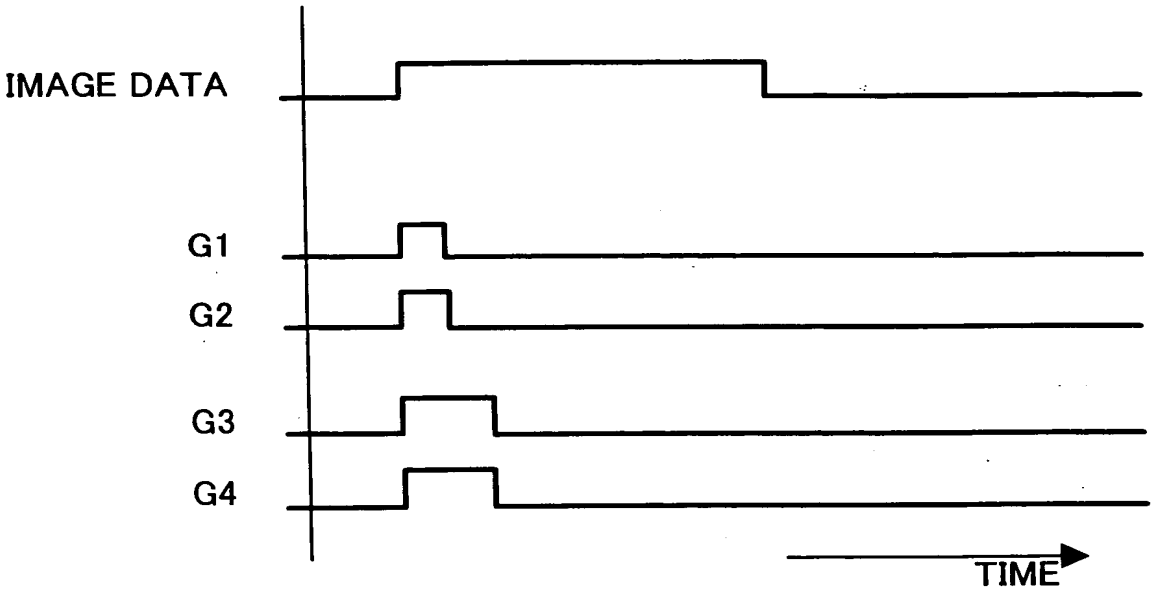


FIG. 6B

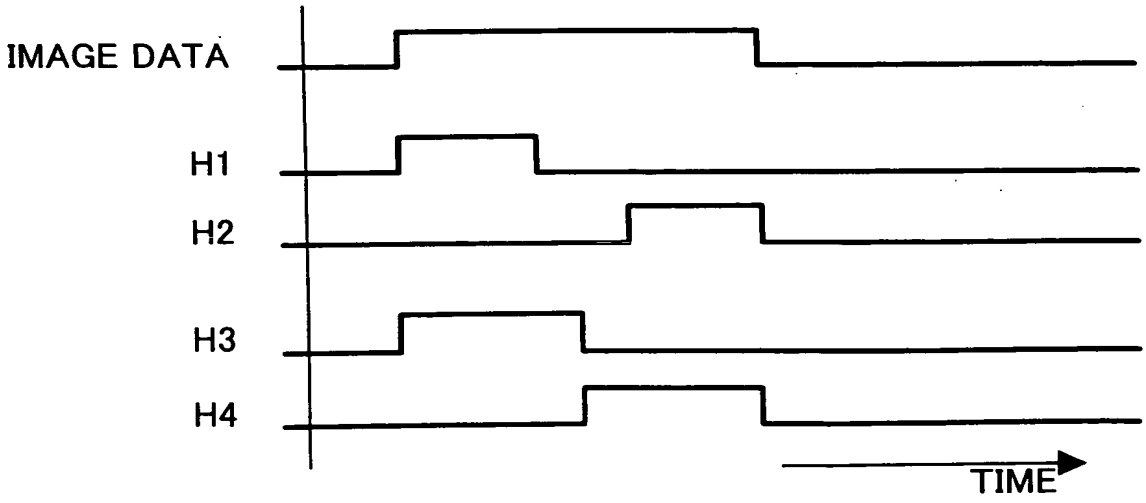


FIG. 6C

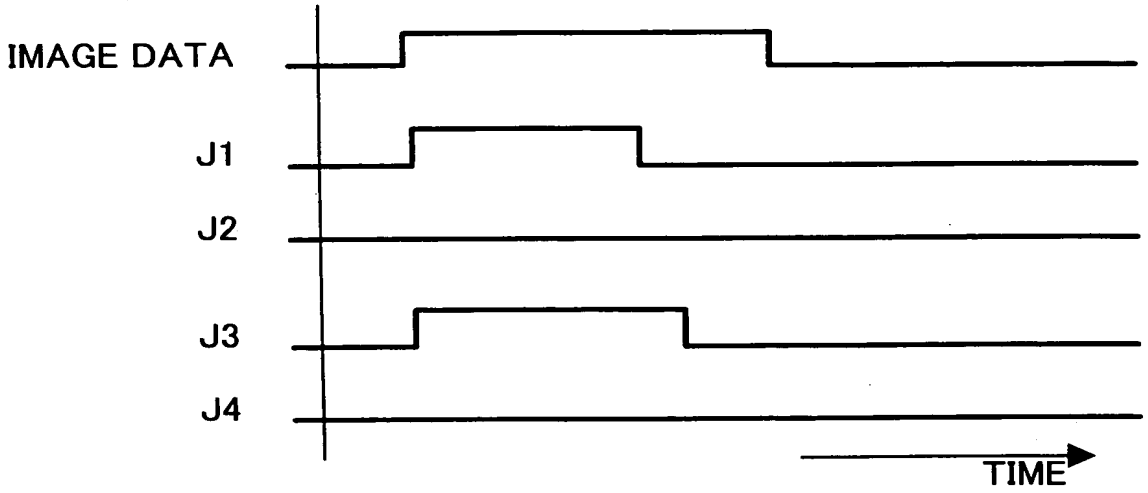


FIG. 6D

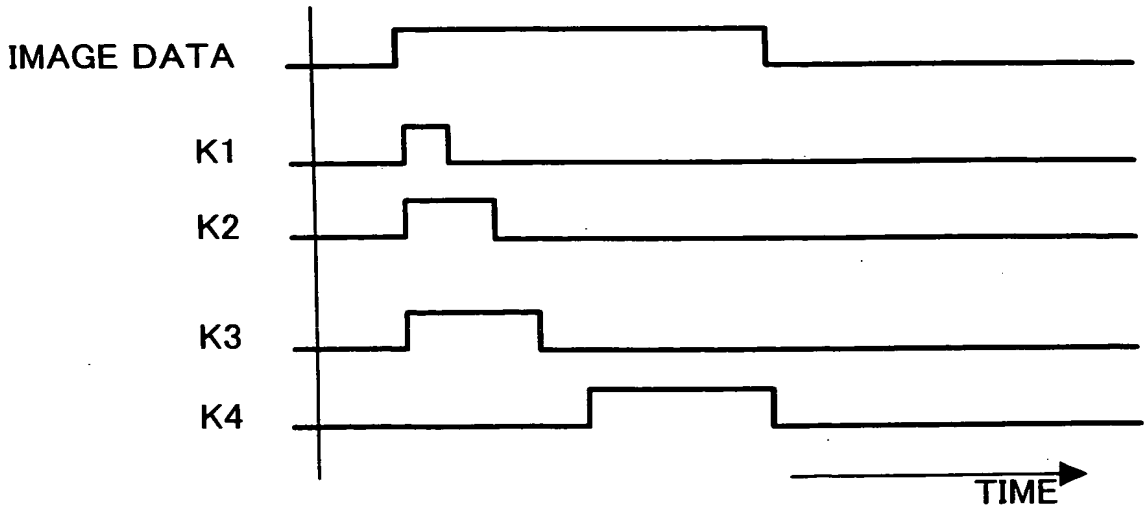


FIG. 7A

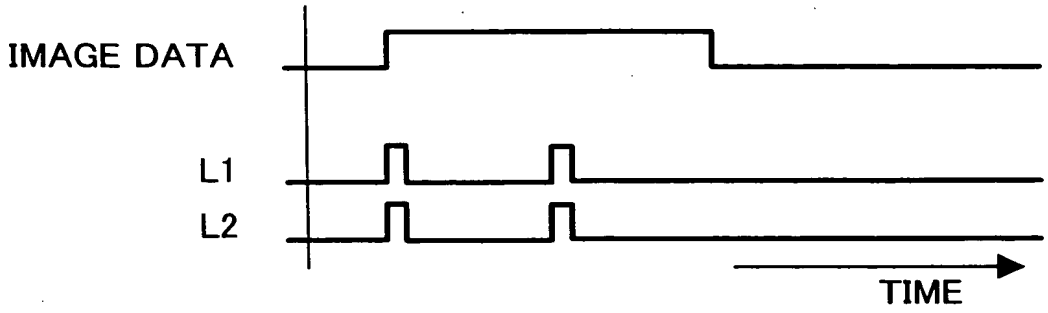


FIG. 7B

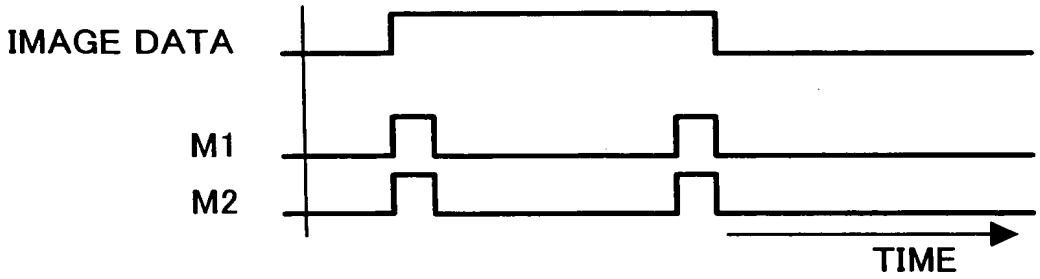


FIG. 7C

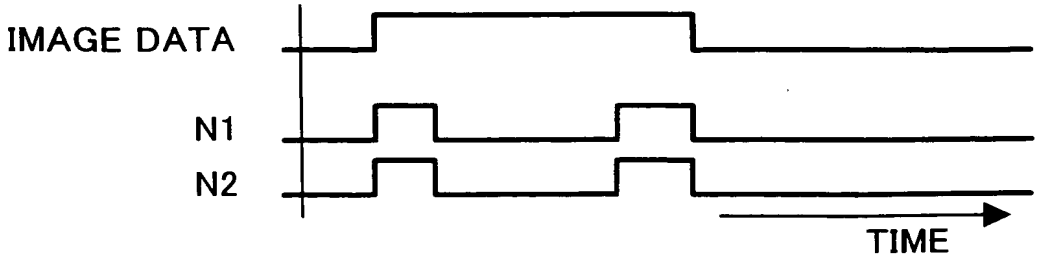


FIG. 7D

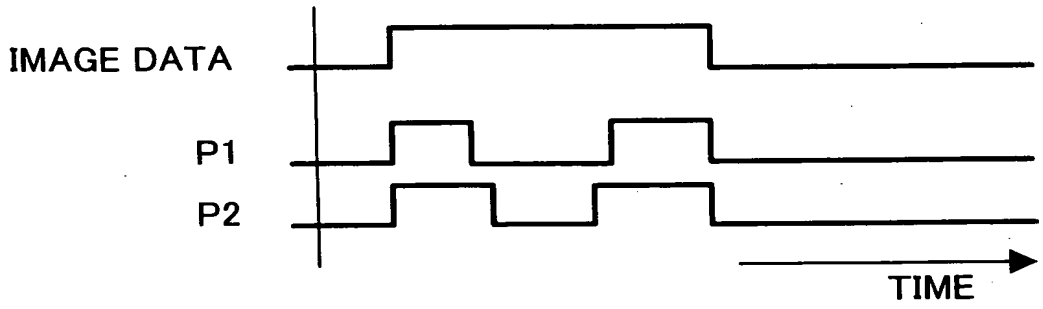


FIG. 7E

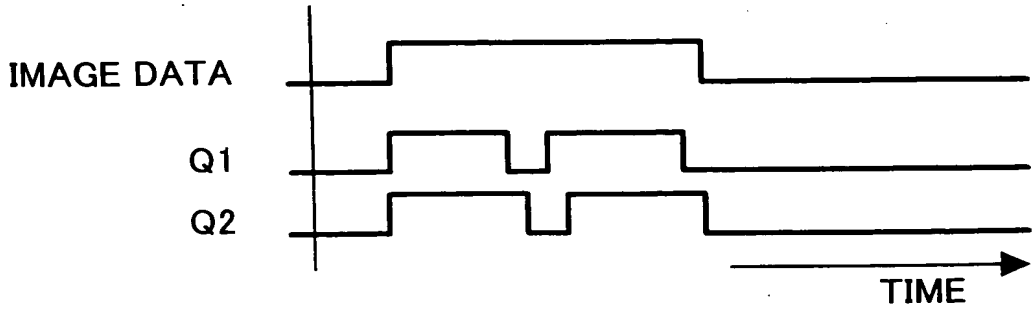
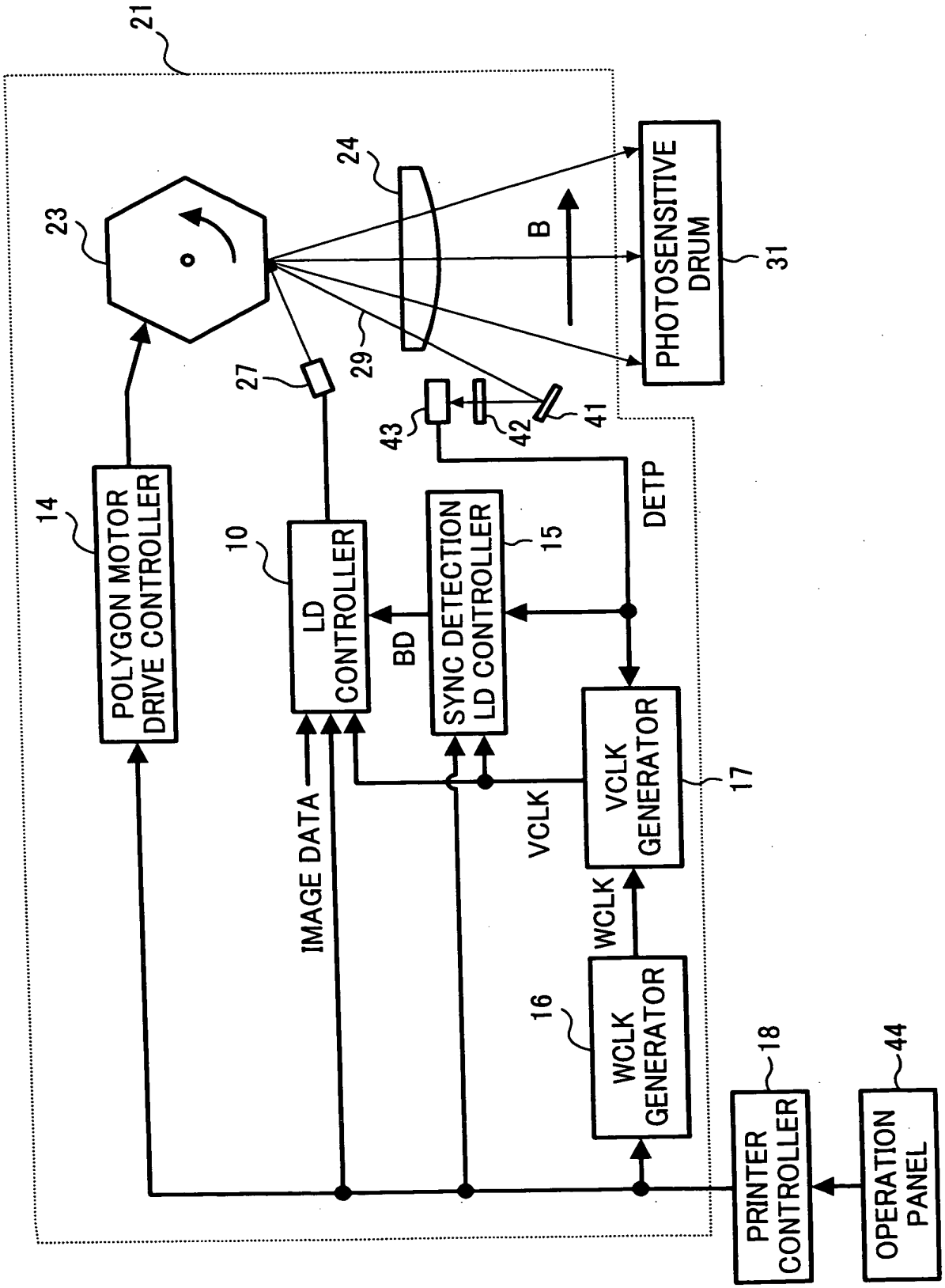


FIG. 8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POLYGON MOTOR DRIVE CONTROLLER
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LD CONTROLLER
BD
SYNC DETECTION LD CONTROLLER
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IMAGE DATA
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VCLK GENERATOR
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WCLK
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WCLK GENERATOR
PRINTER CONTROLLER
18
OPERATION PANEL
44

FIG. 9

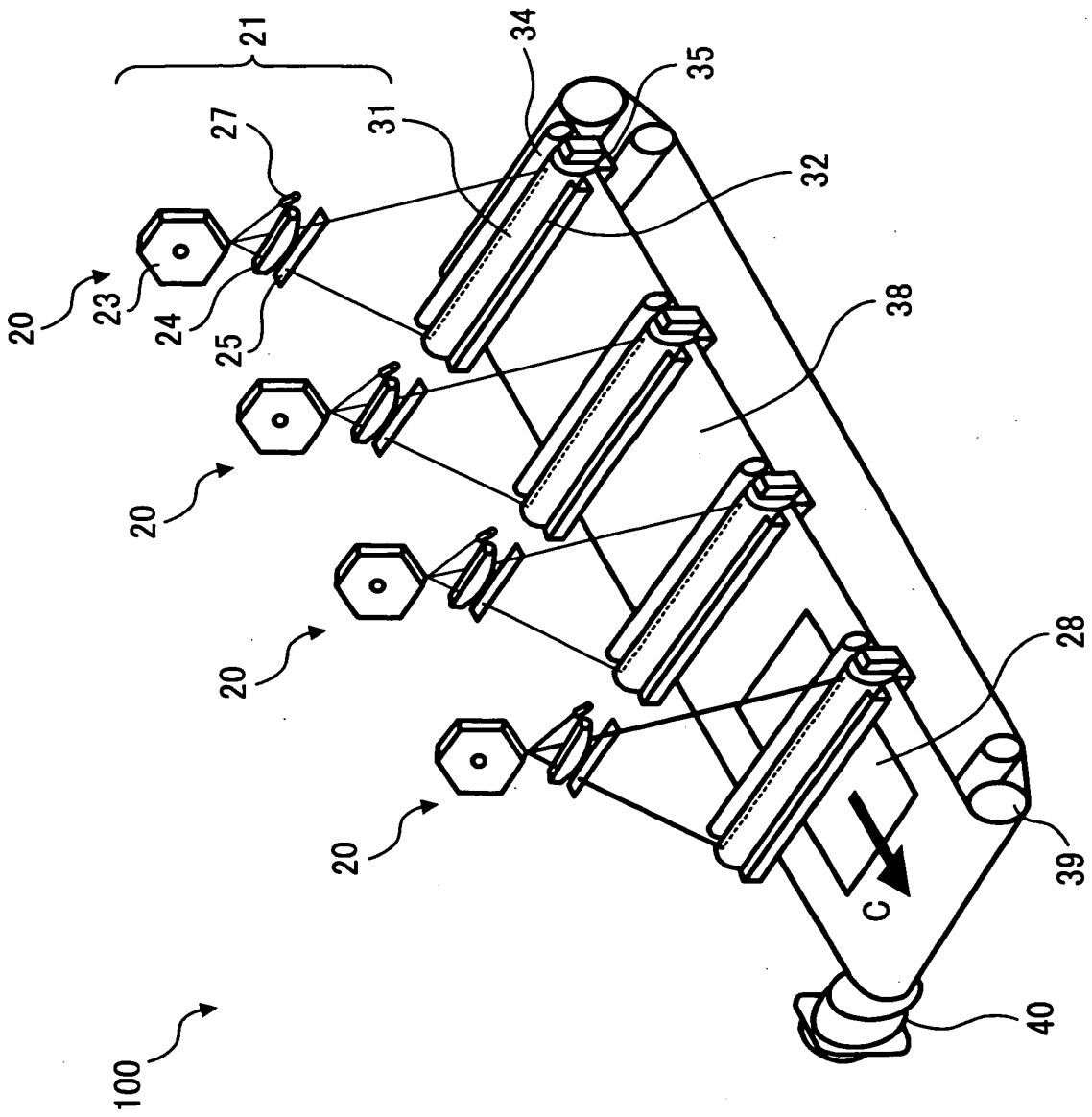
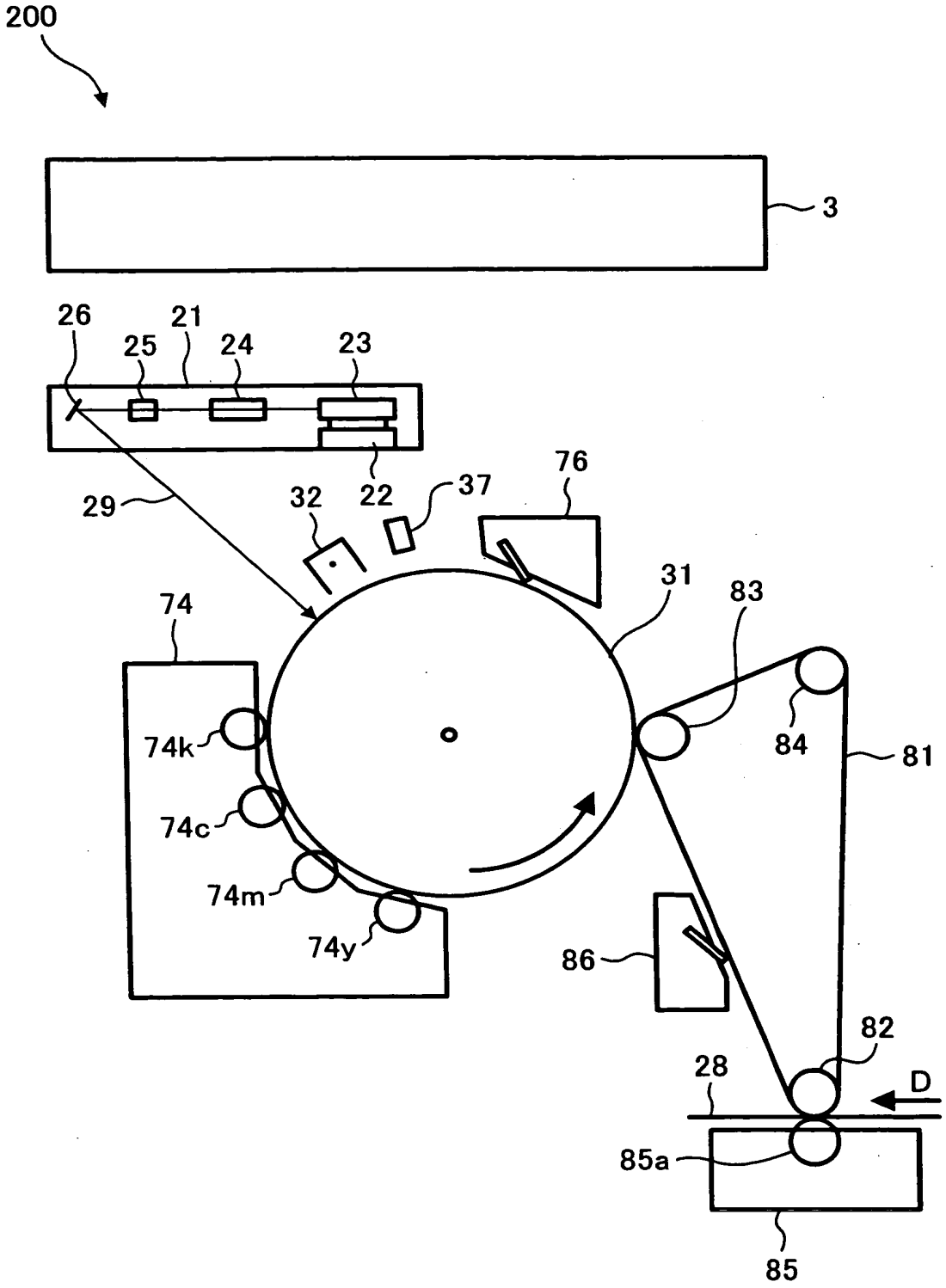


FIG. 10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28
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FIG. 11
(Prior Art)